Difference of Proficiency in Wooden Tub Manufacturing

Shuhei Yasuda[1(✉)], Keisuke Ono[1], Ryo Takematsu[1], Mayuko Toyooka[2], Masakazu Aoshima[2], Takeshi Ueshiba[2], and Hiroyuki Hamada[1]

[1] Department of Advanced Fibro Science, Kyoto Institute of Technology, Kyoto, Japan
s.yasuda312@gmail.com, ekusiek0223@gmail.com, takematsu4@gmail.com, hhamada@kit.ac.jp
[2] Fujii Barrel Manufacturing, Sakai, Osaka, Japan
mayufuji7@hotmail.com, oketarou863@gmail.com, clubman0223@gmail.com

Abstract. Kioke (wooden tub) production, which is a traditional industry, is gathering attention recently because of its great ability for brewing. However, producers of kioke are decreasing year by year, and it may also lead to crisis in oral tradition of production method of kioke resulting from this situation. In this research, the movement of kioke manufacturing was analyzed in order to change the tacit knowledge to explication of knowledge. As a result, there is clearly difference be-tween expert and non-expert, and it could be expressed as values.

Keywords: Wooden tub · Traditional industry · Proficiency · Motion analysis

1 Introduction

Kioke (wooden tub), which is a Japanese traditional product, has started to gather attention again. Kioke is a general term for any cylindrical container made of wood, and it is traditionally indispensable for brewing of sake, soy sauce or miso. In recent years, because of hygienic or cost concerns, it has been supplanted by plastic product. However, because of its many superior properties in production of fermented food, kioke is being reevaluated. The 50 % of the total composition of kioke is formed by fine fibrous cell wall made of cellulose and there are fibrils pores on its woody surface. As these pores become an environment suitable for the existence of microorganism necessary for fermentation, a kioke comes to possess characteristics as fermentation container that cannot be found in other types of containers [1]. Figure 1 shows the structure of a kioke [2]. A kioke has an extremely simple structure consisting of side plates, a base plate and bamboo hoops. The production of a kioke can be roughly divided into the production steps of these 3 parts, and production of each part requires different craftsmanship. However, a large kioke with about the size of 2.3 m diameter and 1.95 m height, which is used for brewing of miso or soy sauce, has a very long life span, 30 to 100 years for miso production and 50 to 150 years for soy sauce production. This makes demand for large kioke unstable. Moreover, plastic products have been

V.G. Duffy (Ed.): DHM 2016, LNCS 9745, pp. 518–525, 2016.
DOI: 10.1007/978-3-319-40247-5_52

supplanting conventional kioke in the recent years, leading to almost total disappearance of kioke producers. Due to this situation, there is a concern among the okeshi, who produces kioke, that the traditional skill may disappear, and it is becoming urgent to conserve the skill and train the next generation of kioke craftsman. Thus, in this research, in order to conserve the skill and pass it on, we will quantify the tacit knowledge involved in kioke production, such as knacks and intuitions, and compared/examined the differences in movement between an expert and a non-expert based on these numbers. In this report, we will present the result in owari (rough splitting) process of cut bamboo, which is an early step in the production of bamboo hoops necessary for holding together a kioke.

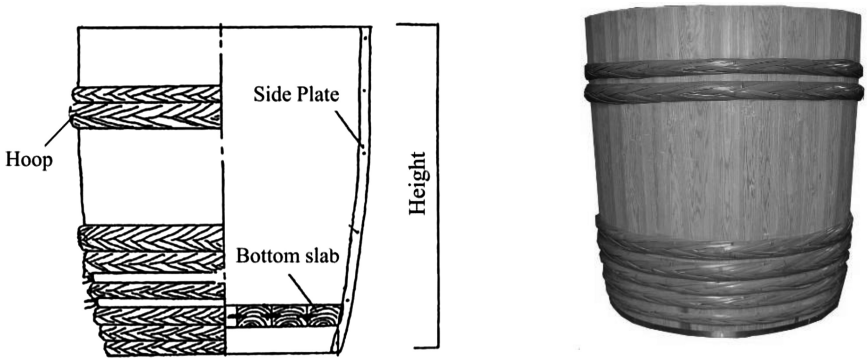

Fig. 1. Structure of kioke.

2 Manufacturing Process

Figure 2 shows manufacturing process of bamboo hoops. The process is roughly classified into 3 works. Those are splitting, plaining and braiding. In splitting process, bamboo is split in suitable width. Splitting process are consists of owari (rough splitting), metori (removing branches) and kowari (fine splitting). After splitting process, a bamboo is plane for the purpose of suitable thickness. The most important thing for making bamboo hoop is stiffness are same in all points in a bamboo. Therefore, workers must adjust for thickness of bamboo with considering about node and other parts. In this process, taper which makes it easier to braid bamboo is also made, and plaining off the corners is conducted. Finally, a bamboo is braided for making hoop. Braiding angle and numbers of bamboo are determined by the size of wooden tub.

Owari (rough splitting) is an initial step in the production of bamboo hoops necessary for holding together a kioke. Figure 3 shows the process of rough splitting. Firstly, make a nick on the edge of a cut bamboo using a hatchet, and tuck an iron stick standing on the ground between this nick. And by pushing this bamboo toward the stick, the bamboo is split in half. The bamboo hoop is produced by splitting the cut bamboo into 6 to 10 pieces after the owari process, go thorough thinning process and then finally woven together. Among these steps, the first owari process particularly

demands skill. Normally, there are nodes in a bamboo. Initially, there were branches on nodes. This part of cut bamboo is called metake, is shown in Fig. 4. A metake is harder than other parts, and it becomes an obstacle when weaving a hoop, making its removal necessary. Therefore, at owari process, which is the first step in the production of a hoop, the bamboo has to be cut at right above each metake in order to prepare a homogenous bamboo piece. However, each metake is positioned 180 degree opposite to the one located on the node before, alternating at each node, and moreover they form a spiral throughout a bamboo. This means that when conducting the owari process, the craftsperson has to rotate the bamboo in the direction that he cuts the bamboo against fiber direction between nodes in order to split right above each metake. It is needed to shear the bamboo fiber. Splitting bamboo in perpendicular to direction of fiber is easy, however, it is difficult to shear the fiber and also difficult to tell the method of shear the fiber. Therefore, workers had depended on their knack and intuitions.

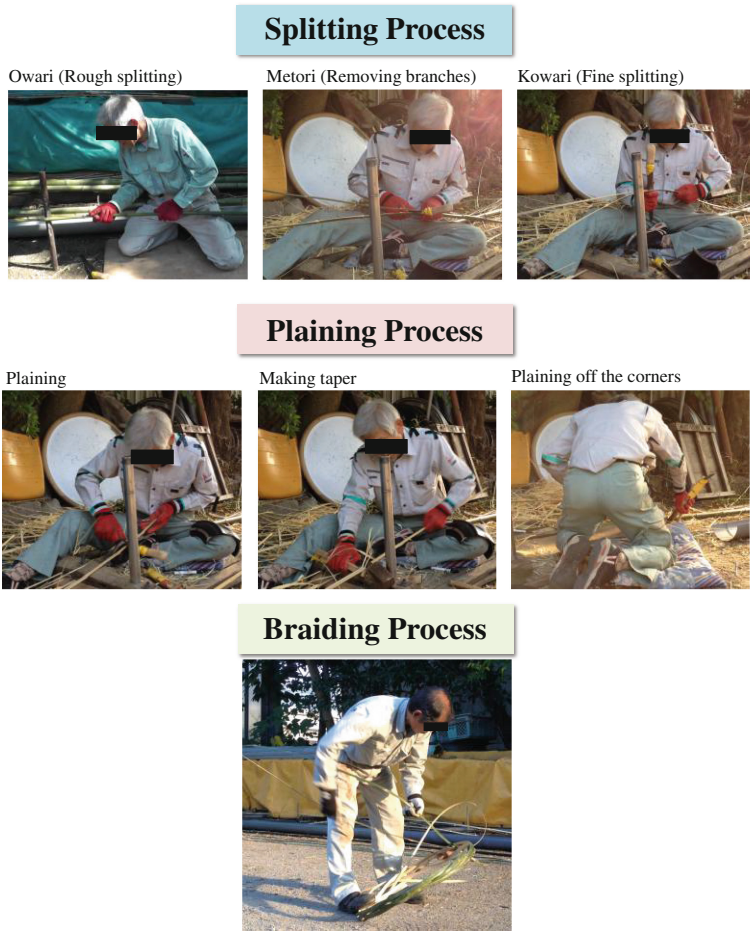

Fig. 2. Manufacturing process of bamboo hoop

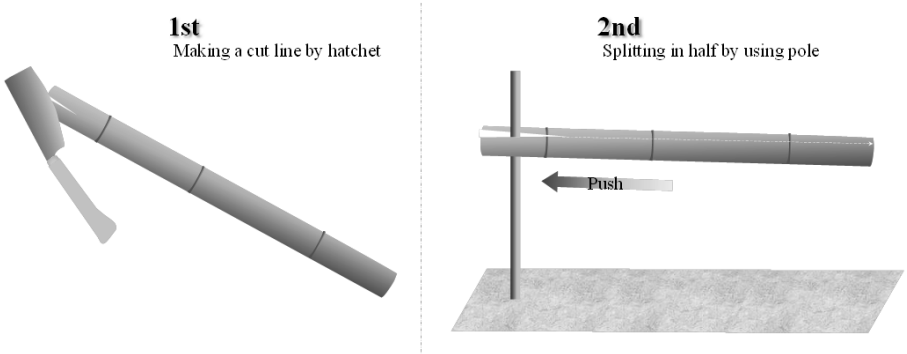

Fig. 3. Process of rough splitting

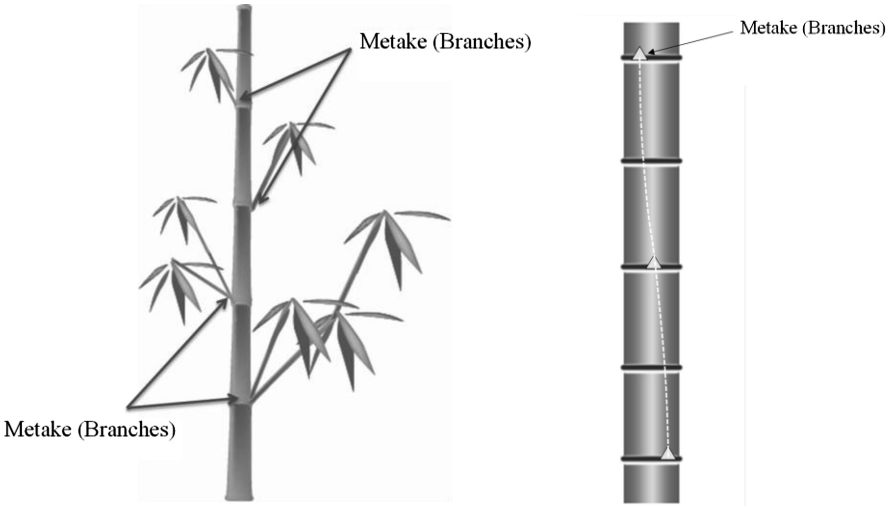

Fig. 4. Structure of bamboo.

3 Experimental Procedure

Table 1 shows the data of the test subjects. The expert is a male with 38 years of kioke production experience, the intermediate is a male with 1 year of experience and non-expert is a male with no experience. Owari process was the object of measuring. Markers were attached to each test subject as sown in Fig. 5, and their movements were recorded using a video camera. Afterward, a moving images analysis software DARTFISH Pro 5.5 (By Dartfish Japan Co., Ltd.) was used to analyze the movement of pushing a cut bamboo toward the iron stick during the owari process. As shown in this Fig. 5, by measuring the d which is the distance from the marker attached to the hands of test subjects and the iron stick, we measured the stroke quantity/pushing speed for each stroke. In addition, quality of owari was evaluated by whether or not a bamboo

was cut in a half. After owari process, length of an arc was measured at each nodes and midpoints between nodes. Amount of gap was calculated by divided a length of arc by a radius of bamboo.

Table 1. Biological data of subjects

Subjects	Age	Years of Experience	Handedness
Expert	65	38	Right
Intermidiate	25	1	Left
Non-Expert	28	0	Right

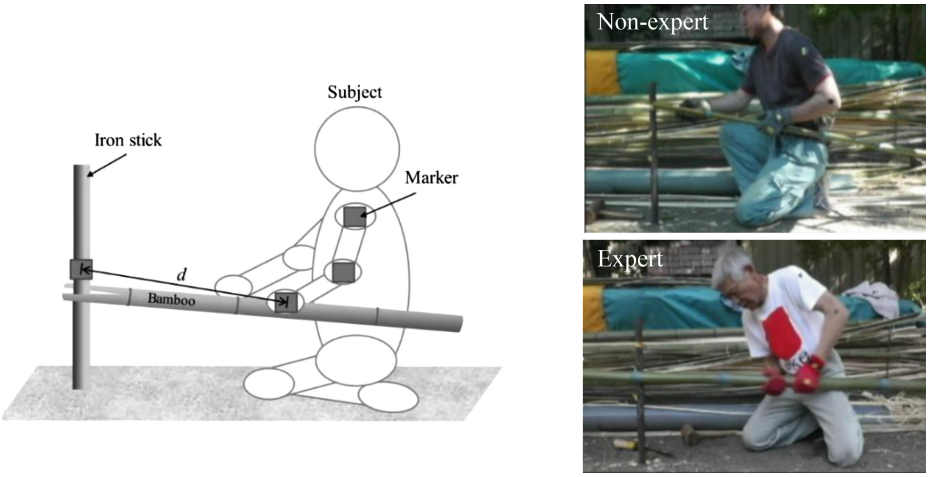

Fig. 5. Attached points of marker

4 Results and Discussion

4.1 Difference in Quality Between the Expert and the Non-Experts

Figure 6 shows amounts of gap of each subject. From the result, expert and Intermediate have slight gaps compared with non-expert. Table 2 shows the average value of gaps of each subject, and the average value of first half and second half are shown respectively. Expert had 2.5 %, intermediate had 2 % and non-expert had 3.9 % gaps as average. Intermediate had the best quality of owari.

There is clearly difference between first half of owari process and second half. In all subjects, amounts of gap in first half is larger than second half. This result means second half of owari process is easier than first half of owari process. A point worthy of

special mention is the difference of gaps of first half between experts and a non-expert is larger than second half. It indicates first half of owari process is required for proficient skills.

It is considered that cause of this result is tapered shape of bamboo. In general, diameter of bamboo is gradually decreasing in the direction of the tip. Therefore, around the base of bamboo is harder than around the tip. In the tip of bamboo, the length of arc which is after splitting is not stable because it is easy to change the direction of crack by a little power (Fig. 7).

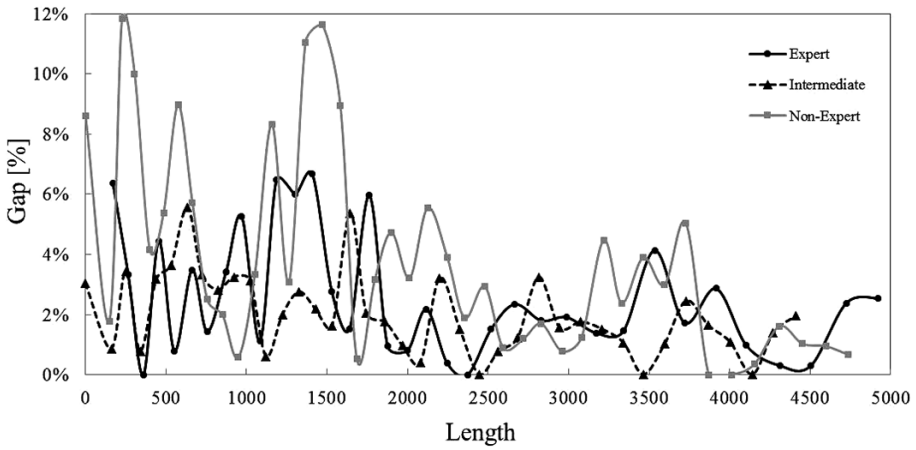

Fig. 6. Relationship between gap and length.

Table 2. Qualty of Owari.

		Expert	Intermidiate	Non-Expert
Gap, %	First half	3.7	2.7	5.8
	Second half	1.5	1.3	2.1
	Average	2.5	2	3.9

4.2 Difference in Movement Between the Expert and the Intermediate

Figure 3 shows the result of strokes measurement, and Table 2 shows the average stroke quantity and average stroke speed of each subject. The vertical axis of Fig. 3 shows the distance from the iron stick to the marker on hand, the horizontal axis shows

the time. The amplitude of the line graph represents the stroke quantity, and the gradient represents the pushing speed. Stroke quantity and speed was gained from calculating numbers from the line graph shown in Fig. 5 and averaged. As a result, it was revealed that the stroke quantity of the expert was 0.13 m larger, and his pushing speed was 0.35 m/s faster, than those of the non-expert (Fig. 8).

Moreover, difference in the posture during the owari process was observed between the expert and the non-expert. While the expert was facing the bamboo during owari process, the non-expert turned his body toward the bamboo while working. When the angles made from the bamboo and the front side of the body of each subject were measured, that of the expert was 65°, and that of the non-expert was 27°. This can be inferred that by facing the bamboo, the expert achieved wider movable scope for his shoulders, which made it easier for him to stroke, leading to the larger stroke quantity. However, we believe that there are many other factors influencing the improvement in time and quality of work, needing further study in future (Table 3).

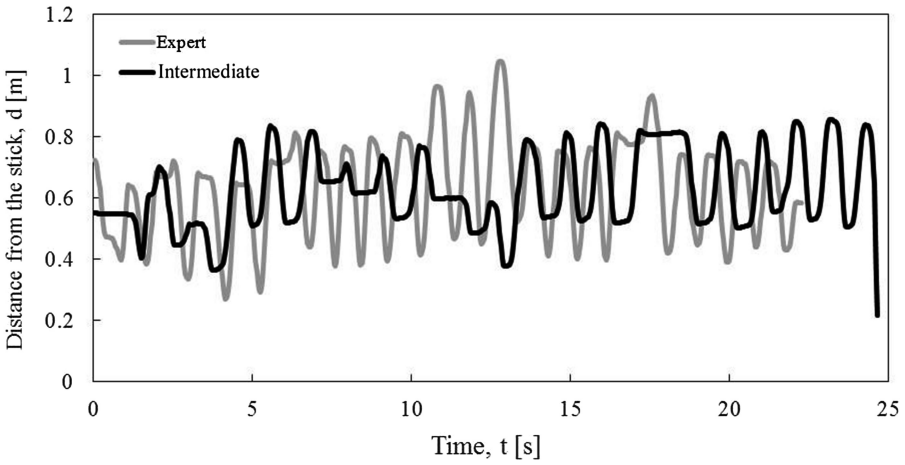

Fig. 7. Relationship between distance from the stick and time

Table 3. Stroke quantity and speed of expert and intermediate

Subjects	Stroke quantity, m	Stroke speed, m/s
Expert	0.37	0.93
Intermediate	0.24	0.58

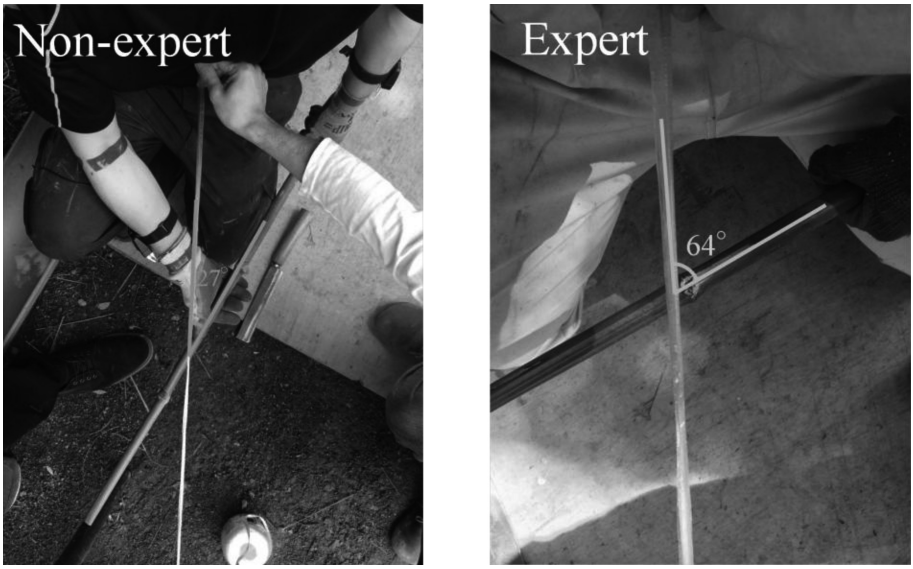

Fig. 8. Difference of positions.

5 Conclusion

In this study, we focused on owari process, which is an initial step in the production of bamboo hoops necessary for holding together a kioke, and examined the difference in movement between the expert and the non-expert. In addition, amount of gap was calculated by divided a length of arc by a radius of bamboo.

As a result, expert had 2.5 %, intermediate had 2 % and non-expert had 3.9 % gaps as average. In all subjects, amounts of gap in first half is larger than second half, and the difference of gaps of first half between experts and a non-expert is larger than second half. It indicates first half of owari process is required for proficient skills.

It was revealed that the expert has larger stroke quantity and faster speed during owari process compared to the non-expert. Moreover, the expert and the non-expert differ in their work posture, and it can be inferred that the expert takes a posture that is easier for him to move his shoulders.

References

1. Ueshiba, T.: The history and development of wooden vat for brewing: wooden vat used in making soy sauce, miso, and rice vinegar. J. Brew. Soc. Jpn. **98**(7), 491–496 (2003)
2. Ishimura, S.: Oke/Taru I. (Foundation) Hosei University Press (1997)